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Parental Leave within the Broader Work-Family Trajectory

What Can We Learn from Sequence analysis?

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Abstract

This paper illustrates how sequence analysis can be used to analyse work-family reconciliation strategies of parents and in particular the role of parental leave in these strategies. The use of administrative records makes a detailed, longitudinal analysis possible, which enables a holistic approach to the question from the broader life-course view. In addition, as an explorative technique, sequence analysis results are a powerful instrument for formulating further research questions. For the paper anonymous administrative records of mothers and fathers working in Luxembourg are used.

Keywords: Work-family reconciliation, parental leave, work-family trajectory, sequence analysis
JEL codes: J13, J16, J18

Contents

1 Introduction

Parental leave can be defined, very briefly, as a policy, which gives parents the right to take some time off from their paid employment in order to take care of young children. In the European Union, and in other industrialised countries, governments assist parents in taking parental leave by guaranteeing their right to return to their previous employment after the leave and, in some cases, by providing them with financial support for the leave period. Parental leave alongside public child care and flexible working arrangement are amongst the main instruments governments can use to support working parents in raising children (Plantenga and Remery, 2005). Parental leave policies have far-reaching consequences for parents' labour force participation, for the well-being of children and for the broader demographic developments Moss and Kamerman (2009). It is therefore not surprising that parental leave has attracted a large body of research from the fields of economics, sociology, social psychology, demography and other fields.

Despite the broad scientific interest in parental leave, there are some important gaps in the available literature. To begin with, very few papers distinguish between time off from work taken under a leave provision and time off from work during which the parent has officially quit his or her employment. There is a crucial difference between the two, as in the first case, parents are guaranteed their right to return to their previous employment, while in the latter case, transition back to the labour force might be more difficult, as it would imply the need for finding a new job for the parent. In addition, the majority of the literature focus on take up rates (what fraction of eligible parents take the leave) and, in fewer cases, return rates (what fraction of parents on parental leave return to employment after the leave period). While an analysis of the starting and ending point of parental leave provides important insights on the policy use levels, focusing exclusively on the short-term results in only partial knowledge of parental decisions, and the incorrect assumption that these decisions do not change over time Hynes and Clarkberg (2005). For example, little is known about parents who return to work after parental leave remain employed in the long term.

This paper aims at filling these gaps in the previous literature on parental leave. The analysis is based on administrative records, which means that

leave policies can be distinguished from vacation leave and time out of the labour market with an absolute certainty. The different kinds of leave policies: maternity, parental and family leave can also be differentiated from one another. This is especially important for providing an accurate analysis of male use of parental leave, as statistics sometimes mix up the shorter paternity leaves with parental leave, leading to an overestimation of the number of fathers using parental leaves (Haataja, 2009).

The paper answers two main questions: what are the broader work-family trajectories of parents and what is the role of parental leave within these trajectories. The analysis is based on longitudinal data and the utilisation of sequence analysis methods makes it possible that the use of leave policies by parents is represented over time and in conjunction with other developments in the work-family reconciliation trajectory, such as work participation, sick leave, unemployment, periods of labour-market inactivity, etc.

The analysis reveals that there is a stunning difference in the way the event of a child born in the family affects the career trajectories of mothers and fathers. The work-family trajectories of mothers take a dramatic turn with the event of birth, resulting in a short-term absence from the labour force (enabled through leave policies) and, in the majority of cases, a reduction of the overall working hours. It is also possible to identify two extreme patterns of behaviour: on the one side mothers for whom the event of birth of a child is followed by a long-term transition to a period of labour market inactivity, and on the other side mothers who maintain a continuous, stable employment career trajectory before and after the birth. In contrast to the diversity of women's career paths, for men, the event of a birth of a child in the household does not represent a disruption in their overall work-family trajectory. Fewer fathers than mothers take parental leave, and there does not seem to be a clear trend of positioning the leave within the five-year period fathers are allowed to take it.

The analysis of parental leave in the longer-term has highlighted some other interesting patterns, suggesting that parental leave is embedded in a longer-term work-family reconciliation strategy. To begin with, for women, part-time leave seems to be a part of a broader work-family strategy of switching to part-time employment after the child is born, as mothers tend to reduce their hours of work engagement after a period of parental leave. For fathers,

there is no such dependency. For both mothers and fathers there seems to be an association between taking parental leave and taking family leave (leave, which parents can use in case their children are sick or have an accident). Finally, the trajectories of leave-takers tend to be different from the trajectories of non-leave takers, even before the child is born, for both men and women. The main implication of the results in this paper is that a holistic approach to the analysis of parental leave via sequence analysis methods can reveal important patterns in the work-family reconciliation behaviour of parents. Based on these findings policies can be defined to address not only short-term, but also long-term issues of work-family reconciliation.

2 Conceptual Approach

In recent years, the political and academic discourse on social policy has focused on how flexibility and security can be ensured throughout the entire life-course. The challenge for policy-makers is how to design social security systems, which can ensure continuity of work and upward mobility, and at the same time, to anticipate and adequately provide for discontinuities, such as time off for care for elderly or young children (Klammer, 2004). The main transitions in the life course, which were previously thought of as single-time points, such as labour market entry and retirement, are being re-visited and increasingly starting to be seen as phases of labour market participation on their own (Klammer, 2004). Therefore, it is only natural, that policy analysis must also move beyond analysing how policies affect the behaviour of individuals based on single-time events towards a more holistic approach, whereby the long-term implications for single-point decisions are examined, as well as their effects over the lives of others or within other aspects of the life-course.

On the macro-level, the excellent analysis of Bovenberg (2005) makes a compelling case for a holistic approach to understanding and designing welfare systems, as isolated piecewise solutions will not bring sustainable results. Looking through the prism of the life-course on the macro-level, he brings forward the idea that the "shrinking middle", where individuals tend to enter the labour-force later on and spend considerable part of their productive

years outside the labour market due to career interruptions, is an issue affecting a number of inter-related policies. Solutions made in isolation may very well resemble communicating vessels, whereas saving money in one area (for example pensions) might relate to increased expenditure in another area (for example health). Therefore the only solution would, again, be in redesigning the entire welfare state to take into account the changing nature of the individual life-courses and the many inter-connected domains within which they unfold.

From a theoretical point of view the life-course perspective provides a useful lens for policy analysis (Mcdaniel and Bernard, 2011). The life-course paradigm has been gaining importance since the second half of the twentieth century. In its essence it links social change with the broader social context and individual behaviour Elder and Giele (2009). The life-course perspective has been adapted to many studies in sociology, demography and other sciences.

With respect to how the life-course perspective can be used in policy analysis, Bernard (2007) summarises the four main principles of the life course perspective, all of which lead to interdisciplinary academic discussions and a dialogue between research and policy. The first principle is that the lives of individuals are longitudinal. Essentially this means that people can only build their futures based on constraints of their past. Researchers and policy makers must recognise that in making decisions people do not only evaluate future outcomes, they are also bound to certain courses of action based on previous choices. The second principle is that lives are multidimensional. In other words, individuals contribute to or derive resources from multiple institutions, such as human capital (education system), health capital (health system), economic capital (employment and (labour) markets), social capital (formal and informal relationships or networks; family). The life-course is a product of recursive causal relationships between these different dimensions. In each and every stage a gap in one of these areas may need to be compensated by another. For example poor social capital may result in longer unemployment, which in turn would lead to a lack of economic security and deteriorated health. Third, the life-course perspective recognises that lives are interlinked. Usually the decisions an individual makes do not affect only his or her own life course, but also the life courses of these around them, being their family members, co-workers or even members of the general pub-

lic. At the same time the life course of each individual is affected by events in the lives of others. For example an illness of a parent, a birth of child, unemployment of a spouse would all have profound consequences for one's decision regarding their labour force participation, allocation of time or other resources. A relevant study to mention here is the work of Berger and Fleisher (1984) who find that the labour supply of the female spouse of the family is affected by an illness of the male spouse. Fourth, the life-course perspective recognises that lives are lived in a social context. Recently, there have been several publications linking individual life courses with the broader institutional context - i.e. the welfare state (Anxo and Boulin, 2006; Anxo et al., 2006, 2011). In general the resources available in the broader context can influences people's lives in two main channels: proximity and rules of access (defined via market mechanisms, formal rights or informal relationships).

In addition to the four main principles, Bernard (2008) discusses the two cross-cutting themes in the life course perspective, which are inter-linked with them. The first theme refers to the idea of cumulative disadvantage. Even small initial differences in terms of opportunities or constraints can magnify over the life-course and lead to huge disparities later on in life. For example, two children with the same learning disability will have dramatically different outcomes in their educational attainment later on if in one of them the disability is discovered after entry into the formal educational system and not before that. The second underlining theme is the idea of scenarios. The main idea is that people are provided with scenarios that define what actions are appropriate or not. Those can have a descriptive and/or prescriptive nature. Either way these are powerful frameworks that have an influence on the individual decision making and preferred choice of actions. An interesting article to mention here is the study by Kirby and Krone (2002) who analyse how it can be the case in organisations that *de facto* access to family benefits is constrained to lack of organisational efforts to engrain the benefits within the organisational culture and to frame using them as appropriate models of behaviour.

From a methodological point of view, an excellent article by Billari (2005) provides an overview of two of the main approaches to studying the life-course: namely the event-based approach, concerned mainly with modelling duration until specific life-significant events and the holistic approach aimed at reconstructing entire life-histories using sequence analysis methods and

analysing them as a whole. In his analysis Billari (2005) places an emphasis on the complementarity of the two approaches: that is no one of them is better than the other, but rather they reveal different knowledge about the life-course over time and suited to answer different research methods.

Event-history analysis methods[1] are extensively reviewed in the methodological literature (see Mills, 2011) and they are often applied to questions related to work-family reconciliation. Some examples of studies, which have examined how soon after birth mothers return to work and the role or parental leave and institutional or individual-level factors in this process include: Joesch (1994); Ondrich et al. (1996, 2003); Smith and Pylkkänen (2004); Hofferth and Curtin (2006); Lapuerta et al. (2010). In addition, Zhelyazkova (2013) uses a Cox proportional hazard model to analyse male use of parental leave on the same data set. A defining feature of event-based methods of analysis is the need to focus on a single event for the analysis, as opposed to trace how multiple events and transitions take place over time.

This paper aims at a more holistic approach to studying parental leave use of parents and it turns to the tools offered by the sequence analysis methods. Sequence analysis was introduced to the social sciences by Andrew Abbott in the early 1990s. One of the earliest papers documenting the method and proposing its application in the social sciences is Abbott (1990), while Abbott and Tsay (2000) provides a review of the developments in the field a decade later. A more recent review of studies applying sequence analysis methods in the social sciences is available in Aisenbrey and Fasang (2010) and the latest available paper summarising the state of sequence analysis research and the main scientific debates and controversies around the method has been presented by Blanchard et al. (2012) as the introduction to the Conference on Sequence Analysis, which took place in Lausanne in the summer of 2012.

In short, sequence analysis is concerned with the analysis of sequences of states or events. The timing and order of occurrence, as well as durations for which individuals spend time in particular states are all possible points of interest in sequence analysis. For performing sequence analysis, one needs to be able to arrange the elements that are being studied (for example: significant life events, career transitions) along a temporal or spatial dimension

[1]Known also as survival analysis methods or duration models.

Abbott and Tsay (2000). For example, if we try to represent the life-course of individuals in terms of education (E), working(W), not working (NW) and retirement (R), we could distinguish between individuals who transition directly to work after education and then retire (for example: E-W-R) and individuals who return to education one or several times throughout their working career(for example: E-W-E-W-R). Once the sequences are structured, one needs to find a way to compare them. The general practice is the construction of a distance matrix, where each sequence is compared to all other sequences in the data set. Although this has become somewhat of the standard approach, Abbott (1990) notes that there are methods to analyse sequences that are not based on relative distances between them. Having the distance matrix, the researcher can continue to "grouping" similar sequences together (for example via a clustering algorithm) or to search for representative sequences in order to identify the main trends in the patterns (Abbott, 1990)[2]. The analysis can then be moved to the analytical level by trying to explain what caused particular patterns [3] or to use them as explanatory variables to predict later outcomes in the life-course[4].

The present study applies sequence analysis methods to the study of the use of leave policies by parents. The main idea is that the analysis allows for the four dimensions of the life-course perspective to be incorporated. To begin with, to build the sequences, longitudinal data is used, which means that developments over time can be traced. In addition, trajectories are made from diverse elements (states), which allows that different dimensions of the life-course are analysed together. The lives of others (linked lives) are incorporated through the inclusion of birth of a child in the household in the family. Finally the explicit coding of leave policies provides an insight into the role of institutional factors.

This paper provides an overview of the results obtained via reconstructing the work-family career trajectories of working parents in Luxembourg who

[2]For a recent article proposing a detailed theoretical and methodological treatment of how the search for representative sequences can be implemented refer to Gabadinho and Ritschard (2013).

[3]For example Huang and Sverke (2007) relate women's career patterns to family background and attitudes.

[4]For example Joseph et al. (2012) use the career types of IT specialists to predict their compensation.

had a child in 2003. The findings provide a snapshot summary of the work-family reconciliation strategies of working parents, which can provide insights into the workforce participation of parents immediately at the time of the birth (or adoption) and in the course of a period of 8 years. Representing trajectories as state sequences allows that the full complexity of the work-family reconciliation trajectory be captured and synthesised in a way, which is easy to comprehend. There is no need to choose only one of the possible states, for example, only employment status to describe the relationship of each person with the labour market over time - all relevant aspects, such as hours of employment, use of leave policies, health or unemployment spells can be captured at once. In addition to drawing a clear picture of work-family reconciliation strategies, the visual reconstruction of trajectories is a useful starting point for the modelling of the behaviour of parents and formulations further research questions.

3 Literature Review

There are not many studies applying sequence analysis to the study of work-family reconciliation. This is hardly surprising, as few sources of data provide the necessary information over a sufficiently long time period. Work-family reconciliation patterns in men have been examined very seldom in general. One of the few studies that analyse the career data of both men and women with relation to family history is the work of Han and Moen (1999). The authors find that men are over-represented in sequences corresponding to and "orderly career" and "fast-track career", whereas women more frequently have "intermittent", "steady part-time" or "delayed-entry" careers. Even more interesting, the few women who employment careers resembled these of men, were much less likely to have a stable marriage, while the opposite was true for men. The study of Widmer and Ritschard (2009) presents a detailed analysis of the family and occupational careers of men and women from three generational cohorts. The results suggest that occupational trajectories of men do not differ dramatically across cohorts: the norm still remains largely to be a linear move through education, full-time work and retirement. The occupational careers of women, however, exhibit increasing trends of diversification. However, the authors note, the diversification of women's career

trajectories does not mean that there is a lack of order in the sequencing of life stages. Rather, the diversification is largely a result of women moving in and out into paid employment and family work. The overall conclusion of the paper is that the trajectories of men and women are being transformed in rather differing ways. Uncertainty seems to mark only certain parts of the relatively stable male life-course (especially the transition from education to employment) and at the same time it has become a permanent factor in the female trajectories.

Perhaps somewhat more relevant for this paper is the review of studies that focus specifically on the analysis of sequences representing the work-family stages of the life course for men and women. The general findings from the analysis of women's work-family trajectories are that women's life-courses can very roughly be classified as "work-oriented", "combining work and family" and "family-oriented". Trajectories of the first type typically belong to women who spend the majority of their time being employed and who (tend to) have fewer children and employment interruptions. The second category comprises women who spend significant proportions of time outside the labour force, however, who also maintain their labour-market participation. Most studies find that this is the category of women, which can be further broken down into a large number of subgroups, as there are multiple ways in which women achieve their work-family balance (Aassve et al., 2007; Anyadike-Danes and McVicar, 2010; Huang et al., 2007; Huang and Sverke, 2007; Isaksson et al., 2006). Finally, the category of family-oriented consists of women who are predominantly out of employment. In the study of Simonson et al. (2011), this is the group that also has the highest average number of children. Results generally show that this is a very small and declining group of women. For example, in Germany Simonson et al. (2011) found that the "Housewife" group of women has been continuously decreasing in West Germany and has not crossed 10 per cent for East German women included in the analysis. In Britain Aassve et al. (2007) found little evidence for the existence of a predominantly "family-oriented" group. In Sweden, Huang et al. (2007) classified only 20 out of 549 women as predominantly non-employed. Another study, which can be mentioned here is the work of Isaksson et al. (2006), who analysed the career trajectories of a sub-sample from the data set used by Huang and Sverke (2007) and Huang et al. (2007). The analysis revealed, similarly to the findings in Huang and Sverke (2007) and Huang et al. (2007) that the predominant patterns of female trajectories

in Sweden were characterised by upward mobility or stable participation in the labour force even throughout child-bearing years.

After identifying dominant patterns of female work-family reconciliation, researchers either try to explain these patterns or to relate them to outcomes later in life. One direction of research whether work-family reconciliation trajectories are a product of personal values and life-style preferences. Some scholars, (for example: Huang and Sverke, 2007; Aassve et al., 2007; Huang et al., 2007) have related the three broad groups of female trajectories to theory developed by Hakim (2002), according to which women's life-style preferences and values determine their work-family trajectories. In the theory of Hakim, women are broadly grouped into family-oriented homemakers, work-oriented and work-family combining(adaptive) types, whereby their lifestyles are a product of their personal preferences. In Huang et al. (2007), the general findings were in line with this reasoning, as the trajectories of women were found to be in line with their values and career aspirations measured at earlier points in time: for example, women who were in the career-oriented general group scored higher on work values than women in the work-family combing groups, while career-oriented women scored somewhat lower on family-related values. Aassve et al. (2007) emphasise that although the general patterns obtained in their data roughly correspond to the preference-based typology identified by Hakim (2002), the diversity and heterogeneity of the trajectories of women is actually far greater than three types and especially complex patterns are emerging in the group that is trying to combine work and family. Outside of preferences, the role of institutions must also be mentioned, as they enable women to a different extent to construct their life-courses according to their preferences. In line of this, Huang et al. (2007) mention that the number of work-family combining women is very high in Sweden where the institutional set up allows for women to maintain a connection to the labour force. This is also demonstrated in Simonson et al. (2011), where the proportions of women in different general patterns differ dramatically not only across generational cohorts, but also between East and West Germany.

A second direction for analysis of work-family reconciliation patterns is to relate them to outcomes later in life. In Huang et al. (2007) women from the career-oriented groups had a higher level of socio-economic achievements, while women in the predominantly not working group had the lowest health-

status. At the same time, there were no significant differences in terms of job satisfaction or general life satisfaction. The authors observe that the great diversity of women's life courses observed in the analysis, to an extent, reflects the broader institutional and societal context of Sweden, which provides support measures, such as parental leave and public child care to assist women in organising their life courses in a multitude of ways. Nevertheless, it could be added that the differences observed in terms of socio-economic status, reveal that even though women have the freedom to structure their work-family lives, this does not go without long-term, over-reaching consequences. In a related study Huang and Sverke (2007) extended the analysis to account not only for the broader work-family reconciliation strategy, but to also include career developments patters, in terms of upward or downward mobility. The study results indicated links between the occupational career trajectory and overall quality of life. Women with professional career trajectories, in particular, were more likely to experience more role conflict in general, to have less goal clarity and to find it more difficult to balance career and family.

Over the long term, implications of career profiles become even more important, especially as one begins to consider pensions and old-age income. A study by Frommert (2011) on German career histories shows that women are much more likely than men to belong to work trajectory types, such as "family-oriented", "part-time employed" or "marginally employed". Women with these trajectory types are more likely to have more than two children compared to women with other trajectory types. At the same time, however, these are the trajectory types associated with the lowest projected pension income.

Therefore, it is important to identify what exactly are the patterns of entering and exiting the labour force in relation to child-bearing. However, there are several important omissions in the previous literature. To begin with, the role of leave policies and other work-family reconciliation support measures is seldom incorporated in the analysis. Often women on leave are considered employed and the role of institutional factors is inferred indirectly by comparison of the distribution of trajectories with other countries or historical periods. Another issue is that the analysis of complete biographies automatically translates into analysis of people who are in or nearing retirement. As their life-courses unfolded a substantial time period ago, it is difficult to say

whether findings are still relevant in the present context.

The present study extends the previous literature in several important ways. To begin with, I focus on the period of time directly before and after birth of a child. The time-frame studied is similar to the time-frame addressed in Hynes and Clarkberg (2005), who investigate early parenthood. This is an important contribution, because focusing on a shorter time-frame allows for a more detailed, monthly-level analysis. For example, working with a longer time-frame posed computational limitations on the analysis of Anyadike-Danes and McVicar (2010) who had to aggregate their data from monthly to annual. Using monthly data it is possible to identify exact points of entry and exit of the labour-force. Second, the present study specifically looks at the role of leave policies, in conjunction with other social protection measures, such as unemployment and sick leave. Third, I use a much more detailed definition of employment, whereas, I not only distinguish between being in the labour force and working, but I also use the information about the specific hours of employment and trace their development as well. Finally, to the best of my knowledge, this is the first study attempting to present work-family reconciliation strategies of men via sequence analysis methods.

4 Background: Parental Leave in Luxembourg

The analysis for this study is situated in Luxembourg, where parental leave was introduced for the first time in 1999. With administrative records available until the end of 2008, we can observe how individuals are positioning parental leave within their employment trajectories and observe how it plays out in the long term within the substantial time span of ten years.

Parental leave was introduced in 1999 and there have not been major changes in the policy design until now. The latest information about leave policies in Luxembourg can be found on the web site of the Leave Policy Research Network (see Zhelyazkova and Loutsch, 2012). Working parents in Luxembourg have the right to take either a block of six months full-time parental leave or a block of twelve months part-time leave. The leave can be used up to the fifth birthday of the child and is an individual entitlement: both par-

ents have to right of leave (if they meet the eligibility conditions), however, they cannot transfer it to each other. In addition, there is the requirement that the first leave in a two-parent family must be taken immediately after the maternity leave (the period immediately before and after birth, which in Luxembourg is equal to four or five months fully compensated leave. If a parental leave is not taken immediately after the maternity leave the right of the leave is forfeited, however, the second leave (in a case of family of two parents) can still be used until the child turns five.

The eligibility requirements for the leave are a minimum of one year employment with the same employer prior to the start of the leave and a reduction of at least 50% of working hours in the case of taking the leave part-time. In accordance with the European Directive of 96/34/EC of 3 June 1996, the leave is fully job-protected and parents are guaranteed the right to return to the same or an equivalent working position at the end of the leave. Parents who take parental leave are compensated on a flat-rate basis, meaning that everyone receives the same compensation regardless of their previous income. In 1999 the rate of compensation started out at 1496.11 EUR for the full-time leave and half of the amount for the part-time leave. There was an annual adjustment for inflation until 2007, when the compensation rate was frozen at 1778.31 EUR and it has remained at this rate until the time of writing this paper (see portail des statistiques, 2013).

An alternative for parents in Luxembourg is also to use the child-rearing allowance (L'allocation d'éducation). In 2012, the compensation figures were 485.01 EUR full time and 242.51 EUR part-time. Every person in Luxembourg raising a child under two years is eligible for the allowance, however it cannot be combined with parental leave. It is, however, possible to receive the allowance without interrupting one's employment, if certain conditions on the level of income and number of children in the family are met. The duration of the allowance is 22 months full time, which means that the total compensation received for the full duration is equal to the one for parental leave. The main difference between the two measures is that the child-rearing allowance does not entail any sort of job-guarantee or preservation of professional rights.

Not much is known about parental leave use in Luxembourg until this point. Some recent studies include a report for the European Commission prepared

by Plasman and Sissoko (2005) and an evaluation performed by KPMG Assurance Advisory Luxembourg (2002). KPMG Assurance Advisory Luxembourg (2002) found that for the period of 1999-2001, 5.3 per cent of the fathers who were eligible to use parental leave used it, compared to 68 per cent of mothers. The annual report of the Luxembourg Ministry of Family and Integration provides a complete overview of the usage of the Parental leave covering years 1999-2012. Although usage rates are not equivalent to take up rates, the report shows a number of interesting developments over time. To begin with, there is a marked increase in the number of users of leave over time from only 1323 in 1999 to 4025 in 2012. Second, although women remain the majority of leave users, the share of male users has been steadily rising, reaching as had as 23.4 per cent in 2012. Finally, men and women tend to use the leave in different ways: mothers are more often using the "first" leave available for the family, while fathers are more likely to use the "second" leave. Mothers also tend to be more likely to take full-time leave, while fathers take it part-time.

5 Data

5.1 Sample Selection

Data for the analysis are extracted from anonymous social security records by the *Inspection générale de la sécurité sociale (IGSS)* Luxembourg. In Luxembourg, a social security record is maintained for all employed persons in the country except for these working in the structures of the European Commission or the European Court of Justice. Non-Luxembourgish nationals working in Luxembourg (cross-border workers) also have social security records and are included in the analysis. For the analysis, I selected all records where there was a child born in the fiscal household[5] in 2003 and where the worker would be eligible for parental leave [6]. The final data set

[5]The fiscal households are artificially reconstructed households based on tax-related documents. In rare cases it is possible that children in the fiscal household are not biological children, but children from a prior marriage of a spouse, grandchildren, nieces or nephews.

[6]Eligibility for the leave was defined according to the parental leave eligibility rules of Luxembourg. Fathers who worked for the same employer for a minimum of one year and

used for the analysis contains the employment histories of 5827 men and 4481 women, who all had a child born in their household in 2003[7]. Characteristics of the parents included in the final sample are summarised in Table 6 in Appendix A.

5.2 Reconstruction of Trajectories

For this project, the trajectories of individuals could be reconstructed using information from the administrative records, which is provided on a monthly basis. This means that for every month throughout the observation period, for all individuals it is possible to find out what social security payments they have received. However, the records are not created for research purposes, which means that the information had to be re-structured before it is suitable for analysis. The major problem that needed to be solved was how to deal with situations when an individual has received more than one social-security payment? Especially for the short-term job-protected leaves, there were considerable overlaps: for example it is normal that a worker can take one day of sick leave and two days of family leave in the same month, all the while maintaining a state of employment. Another sort of ambiguity were states that started mid-month. For example the month where maternity leave ends and parental leave begins would have both records. However, which one should we choose to record in order to maintain consistency for the whole sample?

Due to the above-mentioned problems with states occurring in the same month or beginning mid-month, the starting point of the data preparation process was a file containing multiple records for each individual for each month. However, for sequence analysis for each individual, there must be one and only one state for each period. The final outcome of the data-preparation process was a data set organised in the so-called *STate Sequence*(STS) format, which is one of the recommended formats for sequence analysis with TraMineR (Gabadinho et al., 2011a). To deal with overlaps and states starting mid-month, I designed an algorithm for choosing a dominant state for

for over 20 hour per week were considered eligible for taking parental leave

[7]The total number of fathers exceeds the number of children born in Luxembourg in 2003 because the data set contains also the career trajectories of cross-border workers.

each month. The algorithm selected one state from all states occurring in the same month in the following order (with the top states taking priority):

1. Birth of child
2. Maternity or Adoption Leave
3. Parental Leave
4. Family Leave
5. Dispense[8]
6. Sick Leave or Accident Leave
7. Unemployment
8. Self-Employed
9. Salary (Uninterrupted Employment)

The procedure used for constructing the trajectories implies that the duration of some states is over-represented. For example, family leave, per definition can last two days per year, however, as its use is important for the analysis, I mark the whole month where it occurs. All states used in the analysis are presented in Appendix B in Table 7.

5.3 Alignment of Trajectories

The year 2003 was chosen as pivotal time-frame for the analysis, as data are available until the end of 2008. Given that parental leave can be taken up to the fifth birthday of the child, observing the behaviour of workers who had a child in 2003 allows to observe the full period for which taking parental leave

[8]Dispense is short-term job-protected leave for pregnant women, which can be used prior to maternity leave in case the job of the mother requires heavy physical work, which might endanger the health of the mother or the unborn baby. All states are described in Appendix B

is possible for the parent. As the study is focused on the work interruption due to the arrival of a new child in the family, all trajectories were aligned according to the first time-point when a decision about taking parental leave could be made. For women, this point is the first month after the end of the maternity leave. For men, the first possible point of taking parental leave is the end of the maternity leave of their female partner. Unfortunately, this time point was not possible to observe precisely and thus the male trajectories were aligned at the event of birth. To make the graphs easier to interpret, I re-coded the time periods of all trajectories to be at time "0" at the point of alignment. Then for all trajectories, I selected for observation 36 months prior to time "0" and all available time points afterwards(51 months for women and 59 months for men). The monthly periods before the birth are marked with a negative sign and the time-periods after the birth are marked with a positive sign. For example, -6 stands for two months prior to the end of maternity leave in 2003 for the female trajectories and 5 months prior to the birth in 2003 in the male trajectories.

6 What are the work-family reconciliation patterns for working mothers and fathers in Luxembourg?

To answer this question, I use two techniques from the Sequence Analysis literature. The first technique is "stacking" all individual trajectories together, which results in the so-called "cross-sectional state distribution plot"(Gabadinho et al., 2011a). In short, this plot provides a visual summary of the proportions of the parents in the sample in each state during any of the time points from the period of observation. The main finding from visually analysing the cross-sectional state distribution is that the event of birth represents a significant life event, which, for the majority of women, results in a change in their work-family trajectory. For the majority of women this change implies taking parental leave and/or (subsequently) reducing their hours of employment. For a small number of women, the event of birth is associated with dropping out of the labour force for a prolonged period of time. For men, on the contrary, the birth event is not associated with any

significant changes in the work-family trajectory. A very small number of men take parental leave, however, it is difficult to find any timing patterns related to the birth per se.

Second, I use "representative" sequences, as a means of summarising the work-family trajectories of men and women in the sample. Representative sequences are constructed based on their relative distance (difference from) to all other sequences in the sample. For this analysis, I follow Gabadinho and Ritschard (2013). The use of representative sequences reveals that the trajectories of fathers are much less diverse than the trajectories of mothers.

6.1 Visual Display of Aggregated Work-Family Reconciliation Trajectories

The collective trajectories of working mothers are displayed in Figure 1 and of working fathers in Figure 2. To interpret the plots, please, note that the horizontal axes corresponds to time (in months), while the vertical axes correspond to proportions. In short, each of the adjacent vertical bars of the graph displays the relative proportions of individuals in each state at any of the months of observation. In Figure 1 all trajectories are aligned at the last month of maternity leave (for the birth in 2003). That is why the 36th month is a red vertical line - at this time point, all women in the sample are on maternity leave. In a similar way, the trajectories of fathers in Figure 2 are aligned at the month of the birth in 2003. In Month 0 (m0) all men have a child born, thus we see a vertical yellow line. The alignment is, of course, not based on calendar time. Rather, the events of ending the maternity leave and having a child born in the fiscal household are taken as central points of analysis and the trajectories are horizontally adjusted to these points, so that we can observe the collective work-family reconciliation patterns before or after these events in the lives of the parents in the sample. The two time points were chosen because of the focus on parental leave in the analysis. The first possible time period for both mothers and fathers to take parental leave is the period following the maternity leave. Thus in Figure 1 it is enough to take a quick look to Month 1 (the month appearing after m(0) on the graph) to gain an immediate idea of the proportion of women taking parental leave

full-time or part-time, returning to work or dropping out of the labour force. For men, as they do not take maternity leave, and information on their female partners' leave is not always available, the alignment is at the month of birth.

For easier understanding of the state distribution in each graph, readers can also refer to Table 1, which shows the percentage of men and women in each state for selected months along the trajectory. In both cases, Month 1 is the first month where it is possible for the parents to take parental leave. For women, this is the month immediately after their last month of maternity leave and for men the month after the birth of the child in their household.

An analysis of Figures 1 and 2 reveals some interesting work-family reconciliation patterns in Luxembourg. To begin with, the arrival of a child in the family is clearly a turning point in the work-family trajectories of women in Luxembourg. This is evident from a marked overall reduction of hours in the period after the birth. In the state definitions used for constructing the sequences, the lighter shades of blue represent fewer hours of employment. In Figure 1, we see a very clear reduction of the two darkest shades in favour of the two lighter shades. In contrast, Figure 2 shows that for men, the hours of labour-market participation remain constant before and after the birth.

The working trajectories of women seem to be affected also in the period prior to the birth, as the proportions of women on sick/accident leave (pale pink colore) tend to increase dramatically, especially in the six-month period preceding the start of their maternity leave. The cross-sectional representation of sequences used for Figure 1 does not make it clear if this is due to a small number of women taking a long period of sick/accident leave or all women increasing their number of sick leaves for small periods. Next to an increased probability of sick leave, a large proportion of women experience a discontinuity of their career due to being on Dispense leave, a leave granted during pregnancy earlier than maternity leave in cases when working during the pregnancy would endanger the health of the mother or of the unborn child. Especially in the last month before maternity leave, it seems like women have more than 20 per cent chance to be on sick leave or on dispense, or in other words, to not be working. Both the accident leave and the dispense leave are job-protected, which means they cannot be considered career break periods in the formal sense of the term. However, in reality, such periods, clearly in conjunction with an upcoming birth are periods when women are defacto

	Women						Men					
Month	-36	-24	-12	1	+24	+48	-36	-24	-12	1	+24	+48
State	*per cent*						*per cent*					
Maternity/Adoption Leave	3.7	3.7	0.4	0	4.6	2.5	-	-	-	-	-	-
Dispense	0.3	0.3	0	0	0.8	0.3	-	-	-	-	-	-
Birth	0.8	0.8	0	0	1	0.4	1	1.5	0.1	0	0.9	0.6
Part Time Parental Leave	1.3	2.3	1.8	14.3	1.6	1.7	0.1	0.3	0.5	0.4	1.5	1.3
Parental Leave	1.7	2.1	1.2	51.6	3.8	2.6	0.1	0.2	0.3	0.3	0.8	0.6
Employed ¡ 20 hrs/week	4.8	5.4	6.9	3	12.4	10.4	1.7	1.5	1.3	1.3	1.3	1.4
Employed 20 to 39 hrs/week	18.9	22.2	26.6	7.5	25.4	31.2	12.8	15	16.3	16.5	13.3	14.7
Employed 40 hrs/week	35.4	36.8	40.3	8.6	17.8	16.4	32.9	36.3	40.4	41	38.7	37.8
Employed more than 40 hrs/week	13.9	13.5	14.6	3.1	6.9	5.7	26.7	27.3	29.3	27.9	27	24.8
Self Employed	2	2	2.7	1.3	2.6	2.6	3.3	3.6	4.1	4.3	4.4	4.6
Sickness/Accident Leave	2.6	3.3	3.9	1.5	2.2	2.8	5	5.6	6.6	6.1	5.8	5.7
Family Leave	0.1	0.3	0.4	0.5	1.7	2	0	0.1	0.1	0.5	0.9	0.9
Unemployed	0.6	0.6	0.3	0.9	1.7	0.9	0.4	0.4	0.5	1.2	1.1	0.9
Missing with CoInsurance	1.4	2.1	0.4	5.9	9.6	10.8	0.1	0.5	0.1	0.1	0.3	0.6
No record	12.6	4.7	0.6	1.7	7.7	9.8	15.7	7.7	0.5	0.3	3.9	6.2

Table 1: Percent of men and women in all states for selected months

not working and potentially already suffering labour-market consequences.

Parental leave is used very differently by working mothers and working fathers in Luxembourg. A quick look at the dark green colore (full-time parental leave) and lighter green colore (part-time parental leave) in Figures 1 and 2 reveal that the majority of women use their right to parental leave immediately after the end of their maternity leave. For fathers, on the other hand, there does not appear to be a clear time after the birth of the child when they are more likely to use leave, except perhaps a slightly higher probability at the end of the first year after the child is born. The take up patterns over time for men and women are discussed in more details in Section 7.

Working fathers experience virtually no periods of inactivity, while about 10 per cent of mothers are inactive on the labour market throughout the five years of observation after the birth of a child. Periods of inactivity are coded with a light-beige color. Persons who have a social security insurance provided by another person (husband, parent, etc.) and who have no employment record are considered inactive. In comparison, persons who have no employment record and no social security insurance are marked with grey color. These are persons who can be presumed to have left Luxembourg, however, it is not clear if they are working or being inactive on the labor market in another country. Interestingly the proportions of persons without any record are almost the same, and follow similar patterns for mothers and fathers.

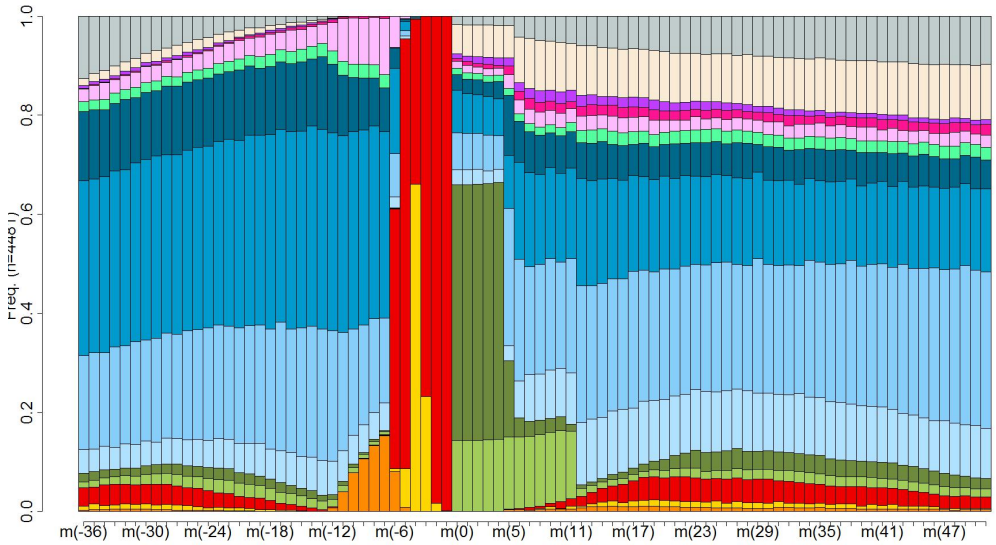


Figure 1: Cross-sectional State Distribution of Working Mothers in Luxembourg who had a child in 2003

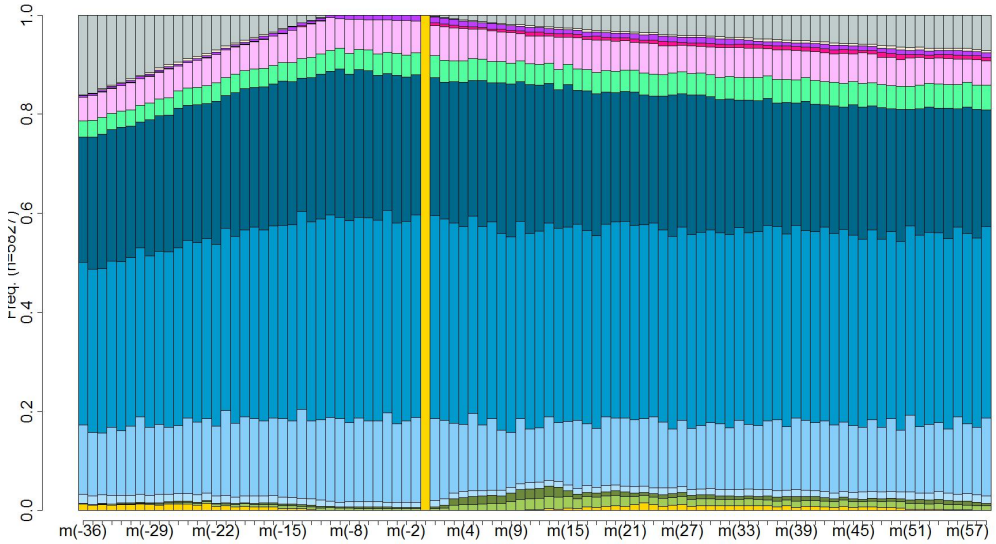
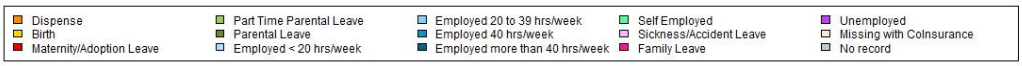


Figure 2: Cross-sectional State Distribution of Working Fathers in Luxembourg who had a child in 2003



In Appendix C, Figure 9 depicts the mean times spent by men and women in each state, as a proportion of total time both before and after the year in which the birth occurred. Figure 9 can be used as a supplement to Figures 1 and 2, as it provides a more accurate comparison of the cumulative duration of states for men and women.

Some mothers in Luxembourg switch to self-employment after child-birth. This is clear from the proportion of persons in the state marked as self-employed, with a sea-green colore in both graphs. For fathers this proportion remains constant throughout the observation period, however, for mothers it increases close to the birth of the child and afterwards.

Working mothers in Luxembourg experience more unemployment than working fathers after the birth of a child. This is observed through the proportion of parents in the state of unemployment, marked with a purple colore. While before the birth, for both genders the proportions are about the same in the period after the birth the proportion of mothers experiencing unemployment increases.

Working mothers in Luxembourg tend to take more family leave than working fathers. Family leave is marked with a deep pink colore. The fraction of women taking family leave increases after the birth compared to the period before birth and compared to the fraction of men taking family leave in the post-birth observation period.

6.2 Representative Sequences

In the previous section, I presented the sequence of cross-sectional distributions of the work-family states for working mothers and fathers. In this section, I change the perspective of the analysis to longitudinal instead of cross-sectional. In other words, I focus on analysing the trajectories of individuals rather than the state distributions. The first step I take in the analysis is to demonstrate how the information from the trajectories can be summarised. In sequence analysis, one possible way to identify an "average" pattern is through the use of representative sequences and representative sequence sets.

Similarly to how the mean would summarise an entire distribution of data points, the representative sequence could be a sequence that would provide an idea of the tendency of the whole group of sequences being examined. In principle, similar like the mean of a distribution is not necessarily a value, which in fact occurs in the distribution (for instance if we are dealing with a variable, such as number of children, finding that the mean is 2.1 children per family still provides useful information about the number of the children in the sample, however, it is still a theoretical value), we could think of a "mean" sequence, which would consist of the states in the alphabet in such order that this theoretical sequence is as close as possible to all the other sequences in the data set. Gabadinho and Ritschard (2013) explain that while this approach may be useful in the biological sciences for summarising, for example, DNA sequence data, in the social sciences it is not so appropriate, as a synthetic theoretical sequence derived in this way may not necessarily have a meaningful interpretation in reality. This is due to the fact that states in social-science-conceptualised sequences often occur in a logical order and are not necessarily independent of each other. This argument certainly holds true for the present analysis. In the trajectories of parents, both maternity leave and parental leave are policies with a fixed duration, and both, occur conditional on a birth preceding them. A synthetic sequence distorting these constraints would not be very useful for summarising the data.

To come up with a meaningful representation, I use first the *medoid* sequence proposed by Gabadinho and Ritschard (2013). In Gabadinho and Ritschard (2013) the medoid sequence is defined as the *observed* sequence, which has the smallest sum of distances from all other sequences in the data set (Kaufman and Rousseeuw 1990 in Gabadinho and Ritschard (2013). In other words, the medoid sequence can be determined after a search for a representative sequence based on the *centrality* criterion. An alternative possibility is to use the *density* criterion, which means searching for sequences with a many similar sequences (high density) within a given neighbourhood radius. This criterion has been applied in the search for representative sequence sets discussed further in this section.

The medoid sequence can be extracted after computing a distance matrix, which represents the distances (differences) between each possible pair of sequences in the data. Computing the distance matrix is typically the first step in sequence analysis, which is also used for identifying groups of sequences

which lie relatively close to each other Abbott (1990). For this analysis, I compute the distance matrix based on the Longest Common Subsequence (LCS) method. A summary of the method can be found in Gabadinho et al. (2011a). In short, the LCS method classifies as more similar these sequences, which have a larger number of elements appearing in the same order in both of them. One must note that a common subsequences can "skip" some elements of the main sequence. For example in the sequence $ST-ST-ML-ML-B$, both $ST-ML$ and $ST-B$ would be considered subsequences. In the latter case, the important factor is that the two elements appear in the same order.[9]

Figures 3 and 4 show the medoid sequences for men and women in the sample. It is hardly surprising that full-time parental leave appears in the medoid sequence for women, and not for men, as Figures 1 and 2 also showed that women are more likely to be using parental leave than men. It must be noted that both of these sequences can be considered to "represent" only 0.045 per cent and 0.017 of the trajectories for women and men respectively. This is not surprising, given the diversity of career paths that can be observed over such a long period of time and the large number of cases in the sample.

As this is a common issue in the social sciences, Gabadinho and Ritschard (2013) introduce a method for extracting a set of representative sequences, as then more diverse sample of sequences can be more fully represented. Their method is implemented in TraMineR. Roughly speaking, the procedure provides a set of sequences (*size of the set*), which "represent" a certain fraction of the entire set of sequences (*coverage of the set*). Both the size and the coverage area can be set by the researcher. When the criterion for extracting representative sequences is the neighbourhood density, the researcher is also required to set the *neighbourhood radius*. The neighbourhood radius is the threshold point for the distances between sequences. For any sequence in the data set, the sequences with distances below this point will be selected into its neighborhoodGabadinho et al. (2011b). In summary the representative sequence set consists of these sequences that are as close as possible to the sequences they represent but at the same time as far as possible from each other.

[9]The LCS method produces the same results as an Optimal Matching with constant indel costs (1) and substitution costs (2) (Elzinga 2007 in Gabadinho et al., 2011a, p.28)

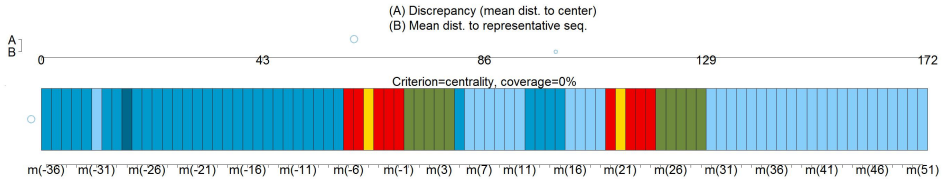


Figure 3: The medoid sequence for women

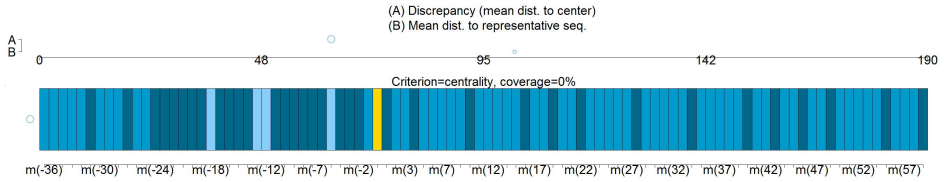


Figure 4: The medoid sequence for men

Figures 10 and 11 in Appendix D display the sets of sequences needed to represent at least 15 per cent of the trajectories for women and men. The difference is quite striking! For women, we would need 34 sequences to represent 15 per cent of the data, while for men, only 8 would suffice to represent (26.12) of the set. In part the high number of sequences that are needed to form the representative sequence sets is due to the level of data-granularity. With monthly data, it is possible to incorporate also short-term states, which, for example with quarterly data would not be included in the analysis. However, it is likely that even with less detailed data, the trajectories of women would be more diverse: for example, there do not appear to be many men who change their working hours after the event of birth or who transition to labour market inactivity.

7 What is the role of parental leave in the work-family trajectories of working parents in Luxembourg?

7.1 Take up of parental leave over time

To answer this question, I present summarised information about the proportion of mothers and fathers who are have taken parental leave at specific time intervals. Tables 2 and 3 show the proportions of mothers and fathers who have taken at least one parental leave at the first possible point they can take it, one year after and at the end of the observation period. Only parents eligible for parental leave are in the sample selected for the analysis, therefore the figures correspond to take-up rates in the first period. [10]The main finding is that, parental leave take up patterns are very different for women compared to men in Luxembourg. The first time period at which women and men can take parental leave is the first month after maternity leave. For women, maternity leave is observed, thus this corresponds to Month 1 in Figure 1. For fathers, the maternity leave of partners is not observed, thus I treat the third month after the month of birth as the first possible month when they can take parental leave. The difference is very pronounced with only 34 per cent of mothers not using leave, and 98 per cent of fathers. There is a very small increase in the proportion of women using parental leave in the coming periods. By the end of the observation period the total proportion of women leave-takers increases only by 6 per cent. That is only 6 per cent of the women who do not use parental leave immediately are likely to use it at a later time point. This is consistent with figures published by the Luxembourg Ministry of Family and Equality (2012), which show that women are much more likely than men to be using the "first" parental leave in the family from the two that would be available for each two-parent family for one child. For the fathers, the figures reveal that by the end of the observation period, about 13 per cent of fathers would take at least one parental leave. A slight majority 8 use it full-time, while the rest take the leave part-time.

[10]In subsequent periods, it is possible that parents lose their eligibility

	One Month	%	Twelve Months	%	Five Years	%
Full Time PL	2313	52	2332	52	2442	54
Part Time PL	643	14	673	15	791	18
No PL	1525	34	1476	33	1248	28

Table 2: Women Parental Leave Take Up

	Three Months	%	Fifteen Months	%	Five Years	%
Full Time PL	76	1	241	4	442	8
Part Time PL	61	1	172	3	334	6
No PL	5690	98	5414	93	5051	87

Table 3: Men Parental Leave Take Up

7.2 What do parents who do not take parental leave do?

Figure 5 displays the state of working mothers and fathers in Luxembourg at the first time point they can be assumed eligible to take parental leave. As the percentages of take up rates are already discussed, the purpose of the figure is to illustrate the activities of these parents who do not take parental leave. In the case of men, the majority who do not take parental leave tend to remain in employment. For women, however, not taking parental leave could result either in return to employment (23 per cent)or in transition to labour market inactivity(6 per cent)as defined by the absence of an employment record and a co-insurance in Luxembourg. Although the fraction of women who transition to inactivity is relatively small, the question why they do not take parental leave is interesting and considers further attention. It is also interesting that about 12 per cent of women resume immediately full-time or even overtime employment. The absolute number of these women

(524)is larger than the absolute number of fathers in parental leave(137)at that time. Although their partners could be on leave in another country, it is quite interesting what resources these families use in order to cope with the increased demands of time after the arrival of the newborn.

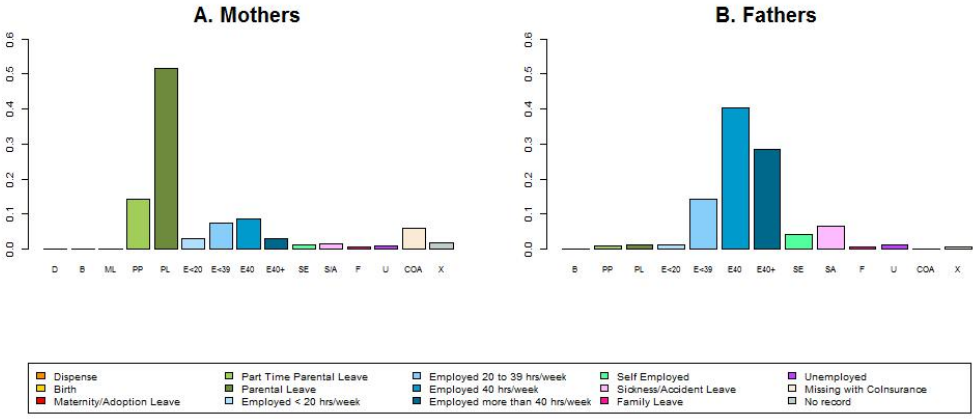


Figure 5: Activities of men and women three months after maternity leave / after birth

7.3 Trajectories of Parents According to Leave-Taking

Figures 6 and 7 show the trajectories of mothers and fathers in Luxembourg split according to their leave-taking behaviour. In Figure 6, the trajectories of working mothers are grouped according to whether they took full-time, part-time or no leave in the first month after maternity leave. The figure split in this way provides an powerful insight of the long-term consequences of each of these three choices. The split was chosen based on the fact that the majority of women take parental leave at this time-point, as shown in Table 2 and it is not clear whether leaves taken later do not refer to other children born later in the family. For fathers, Figure 7 is split according to taking at least once full-time, part-time or no leave for the whole period after the birth of the child in 2003. The reason for this split is that, unlike in the trajectories of mothers, in the trajectories of fathers there is not a

single time-point where the most of leave-taking behaviour takes place and splitting the trajectories in the same way as for the mothers would have not been very informative.

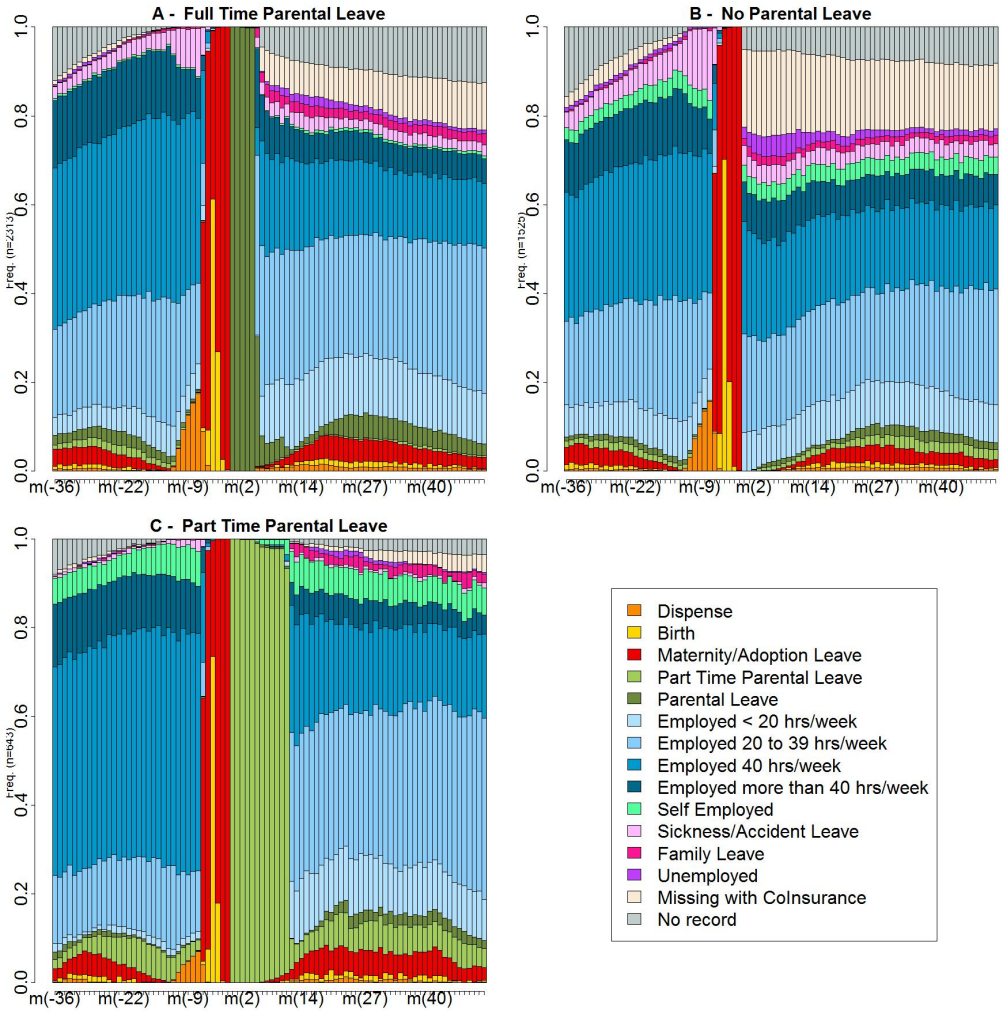


Figure 6: Trajectories of working mothers by leave-taking in first month after maternity leave

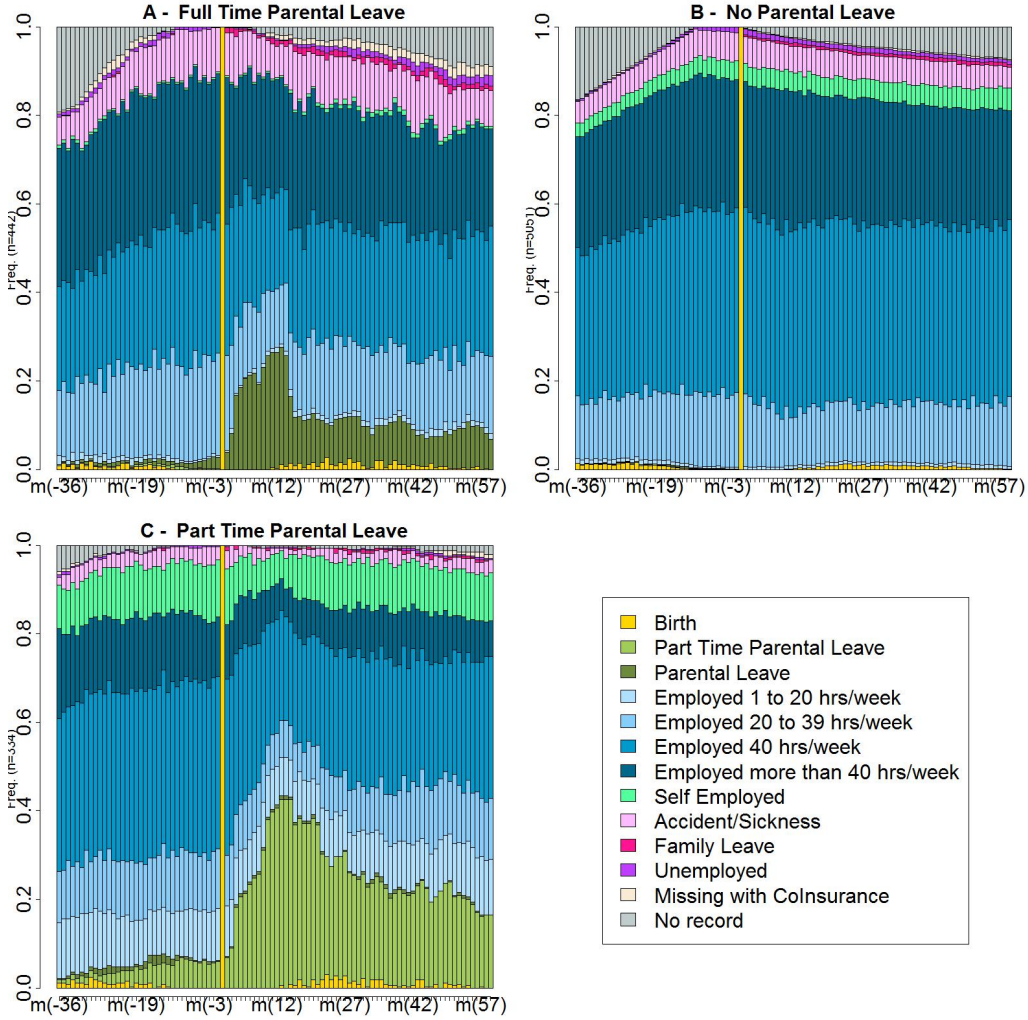


Figure 7: Trajectories of working fathers by leave-taking in five years after birth in 2003

The main finding from Figure 6 is that part-time parental leave seems to almost exclusively result in part-time work, although the majority of women are in full-time employment prior to the birth of the child. It is difficult to discuss causality from this data. One hand, it could be that women in this group decide to switch to part-time employment and use the part-time

parental leave as part of their overall strategy of reducing working hours. It could also be that, at the end of the parental leave period, they find that returning to their previous level of employment would not be easy for them and decide to remain in part-time employment, as their employer obviously has already been able to arrange this change. Another interesting observation is that women who take full-time parental leave seem to have a relative continuity in the overall hours of work-engagement, except for a group of about 10 per cent who transition to inactivity after the full-time parental leave. Again it is difficult to say whether this is due to their change of mind at the end of the leave period or the employers not respecting the right of return to work after the leave. In the group where no parental leave is taken, there is a large fraction of mothers (over 20 per cent) who do not return to employment after parental leave. At the same time, also a relatively large fraction of women seem to return to work immediately and to maintain their full-time or overtime hours of employment.

An analysis of the trajectories of fathers in Figure 7 shows that transition to inactivity is not a concern in the male trajectories. Similarly, an overall tendency to reduce working hours is not observed and the trajectories of fathers seem to remain stable over time in the three cases. At the same time, leaving Luxembourg seems to follow a similar pattern as for the women's trajectories, albeit the fractions are a bit smaller. Fathers who take part-time parental leave seem to be least likely to work overtime, and at the same time, they are more likely to be self-employed. Interestingly fathers taking full-time parental leave tend to have more periods of sickness or accident leave. They are also the group more prone to leave their employment in Luxembourg, with close to 20 per cent of them not working in Luxembourg at the end of the observation period. In both figures there seems to be a relationship between the leave taken in the previous periods (for parents who have had more children before 2003). Mothers taking full-time parental leave after their maternity leave in 2003, seem to be more likely to take full-time leave in subsequent periods, while mothers who took part-time leave seem to have been taking mostly part-time leave before. In parallel, the fathers who took no parental leave in the period after the birth of their child in 2003, seem to not have taken almost any leave in the periods before, whereas for the fathers who have taken leave before, there are larger proportions of the same time of leave in previous time periods.

7.4 Are the trajectories of leave-takers different from the trajectories of non-leave-takers?

A visual inspection of the trajectories of parents grouped by leave-taking in Figures 6 and 7 suggests that there seem to be certain differences in the work-family trajectories of parents. For example, fathers who do not take parental leave seem to have the highest proportion of overtime work both before and after the birth, while fathers who take full-time parental leave seem to have very high proportions of accident or sick leaves in both periods.

7.5 Comparing trajectories: Discrepancy analysis

To carry out a formal comparison of the trajectories of parents according to their leave-taking behaviour, I use discrepancy analysis, a method introduced recently by Studer et al. (2010). I perform the analysis only on the initial part of the trajectories, prior to the birth for men and prior to the last month of maternity leave for women. This means that I compute the distance matrices only for the first 36 months of the observed trajectories. The results of the discrepancy analysis indicate that there is a significant difference between the trajectories of both men and women according to leave-taking. That is, the period of three years prior to the birth is already different for leave-takers and non-leave takers. As in this analysis, I am comparing trajectories and not data points, I explain below the methods of discrepancy analysis briefly.

It would be misleading to compare the trajectories of parents in the period after the birth in 2003, as the trajectories will obviously differ according to the presence or absence of parental leave in them after 2003. Therefore, I concentrate only on the pre-birth part of the trajectory. A formal comparison would reveal whether there are certain patterns in the work-family trajectory, which can reveal whether a parent is more or less likely to use parental leave. Such an analysis could enhance scientific understanding of whether parents who use parental leave are less attached to the labour market (as some studies have suggested) not only close to the birth of a child but also in a longer period before it.

Discrepancy analysis of sequence objects consist in analysing the link between explanatory variables and individual trajectories directly, based on the principles of analysis of variance (ANOVA). For more information, one can refer to Studer et al. (2010). In ANOVA the main idea is to find out how much of the total variance in a chosen dependent variable can be explained by a co-variate. When analysing sequences, it is not appropriate to use the term variance in its classical sense, as comparisons are carried on complex objects and not data points. Studer et al. (2010) introduce the term *discrepancy*, which can, similarly to the variance be obtained by dividing the sum of squares by the total number of observations. When dealing with sequences, the sum of distances from the center is not defined as the squared deviations from the mean, but as the average sum of pairwise dissimilarity between all sequences objects. The pairwise dissimilarity distances can be obtained by an optimal matching or another algorithm.

Once the sum of squares and the discrepancy are defined, the ANOVA principles can be applied in the analysis, whereby the total sum of squares can be decomposed into between- and within sum of squares. Next Studer et al. (2010) propose the subsequent computation of a pseudo R-squared and a pseudo F statistic, which could be used to determine the goodness-of-fit and the statistical significance of the discrepancy analysis test via a permutation test. As the F-test in the ANOVA procedure assumes normality, when extending the formula to complex objects and non-Euclidian distances, the significance of the test cannot be validly assessed via the F-distribution. Instead Studer et al. (2010) propose a permutation test, so that an empirical non-parametric distribution of the F-statistic is calculated, where the co-variate values are randomly assigned to sequences a given p number of times and an F_{perm} value is obtained in each trial (permutation). The empirical distribution of F_{perm} would therefore be the distribution assuming independence between the co-variate and the discrepancy of the sequences, as it would represent the values that would be obtained via a random assignment of the co-variate values. Comparing the actual obtained F statistic with this empirical distribution would then make it possible to draw inferences about the statistical significance of the results.

The results from the discrepancy analysis are displayed in Table 4. Based on the test with 1000 permutations, it seems that the trajectories of leave-takers are significantly different from the trajectories of non-leave takers. This is

true for both men(p=0.001) and women(p = 0.001), however, the leave-taking explains only a very small fraction of the total discrepancy among trajectories, only around 0.7 per cent for men and around 1.1 per cent for women. It is interesting to think where these differences come from? One possibility is that there is a certain level of repetition in the leave-taking behaviour. For example, women who take full-time parental leave may be more likely to continue taking it and so on. Visually examining the trajectories gives some hints in that direction. To explore this question further, one could separate the trajectories of first-time parents from the others and compare the three groups again.

Men (n = 5827)			Women (n = 4481)		
Pseudo-F	Pseudo-R^2	Sig	Pseudo-F	Pseudo-R^2	Sig
19.979	0.007	0.001	24.649	0.011	0.001

Table 4: Results of Discrepancy analysis based on 1000 permutations

7.6 Comparing within-group discrepancy

Studer et al. (2010) propose another possibility to analyse discrepancy of trajectories, which is also of interest for this study. This test is similar to the Levene test for data points. When dealing with data points, the Levene statistic can be used to test whether the variances of two or more groups are the same, while in trajectory analysis the adaptation of Studer et al. (2010) makes it possible to test whether the total discrepancy of two or more groups is statistically significantly different. The results of the analysis based on the Levene test performed on the entire trajectories of parents are displayed in Table 5. The results indicate that for both men and women the trajectories of the three groups have different levels of internal discrepancy.

It is especially interesting to compare the group-level discrepancies. For women, the group with the lowest discrepancy is the group taking part-time parental leave. This means that these trajectories are more similar to each other than the trajectories in the other groups. The highest discrepancy is observed the group of trajectories of women who do not take parental

leave. This means the trajectories of these women vary to a greater extent from each other. These results are not surprising, given the observations from Figure 6, where it is possible to observe that women who take part-time parental leave typically remain in the labour force (albeit with reduced hours of employment), while women who do not take parental leave can follow two very different paths - to leave the labour force or to continue their employment without a significant interruption. For men, the results are quite different. Here, the group with the highest internal discrepancy is the group of men who take part time parental leave, while the group with the lowest discrepancy is the group of men who do not take any parental leave.

-	Men		Women	
-	N	Discrepancy	N	Discrepancy
Full Time Parental Leave	442	59	2313	56.68
Part Time Parental Leave	334	63.68	643	49.23
No Parental Leave	5051	61.09	1525	63.55
Total	5827	62.42	4481	60.69
Levene Statistic		8.24		533.33
Significance		0.002		0.001

Table 5: Levene Test on the entire trajectory of men and women

7.7 Comparing discrepancies over time

Studer et al. (2011) extend the idea of discrepancy analysis to also include the tracing of the strength of the association between co-variates and the within-group discrepancy over time. The analysis can be done graphically via functions integrated with TraMineR and is suited to analysing questions related to accumulation of advantages and disadvantages over time, as elaborated earlier. The idea behind the analysis is to explore overlapping segments of the trajectories and to plot the R-squared values and the values of within-groups discrepancies for each segment. Studer et al. (2011) note that this approach builds up on the idea to trace the evolution of entropies over time, based on co-variates, which has been applied in other studies (such as Billari 2000 or Widmer and Ritschard 2009 cited in Studer et al. (2011)) and would be equivalent to studying the association between co-variates and trajecto-

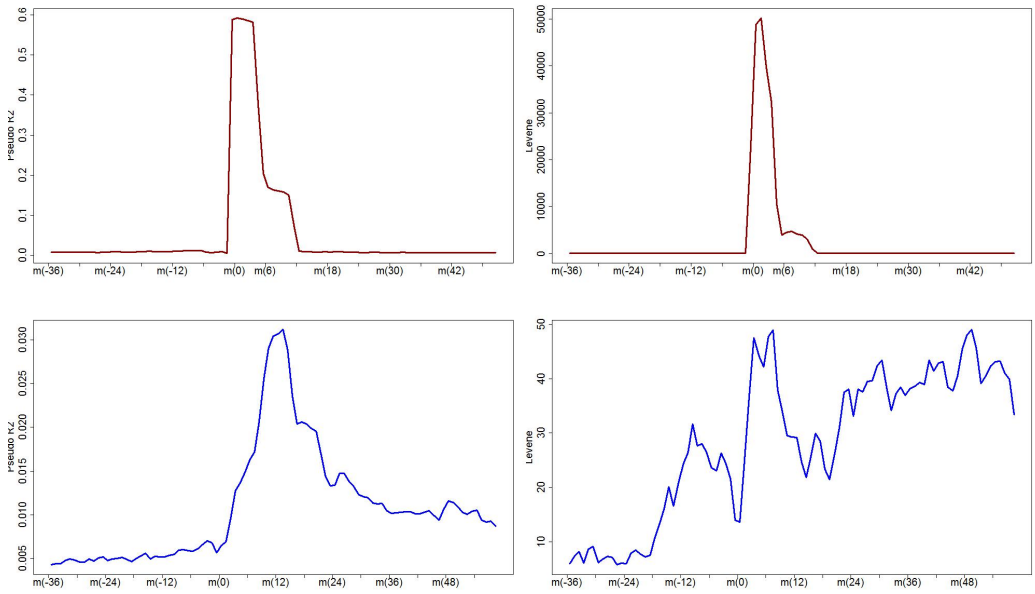


Figure 8: Time Evolution of $pseudo - R^2$ (left) and the Levene Statistic(right) based on leave-taking behaviour for women(top) and men (bottom)

ries within windows of length one. One potential limitation of the approach is that the influence of only one co-variate at a time can be traced.

Plotting the time-evolution of the $pseudo - R^2$ and of the Levene statistic over time renders some interesting insights. The results are shown in Figure 8. The $pseudo - R^2$ and the Levene statistics are quite close to zero before and after the period of maternity and the first parental leave for women. Taking parental leave immediately after maternity leave does not seem to explain the total or the within-group discrepancy of trajectories in the period after the birth. Rather, it seems like it is a very powerful explanatory factor only at the time when most women actually take parental leave (the first year after maternity leave). For men, however, the evolution of these two statistics seems to follow a dramatically different pattern. Leave-taking following the birth in 2003 seems to be explaining a greater fraction of the overall discrepancy of trajectories even before the period of the birth and its explanatory power seems to persist and increase over time. The same is true

for the Levene statistic. It is difficult to say what these results mean exactly, as there is not really a way to know what aspects of the trajectories are driving the difference. However, one possible interpretation is that for women, in the majority of cases parental leave serves as a work-family reconciliation tool and its short-term use does not result in pronounced differences over time. For men, however, it seems like we are talking about different kinds of fathers who take parental leave and who do not.

8 Discussion and main directions for further analysis

This paper serves multiple purposes. To begin with, it aims to illustrate how work-family trajectories can be reconstructed based on administrative records and how sequence analysis can be applied to analyse them. The main idea behind such an attempt is to link political and academic discourse on a life-course approach to social policy and welfare system design to an analytical strategy and a practical empirical application. Such an analysis is possible, however, one needs to have very accurate, longitudinal records and a number of steps in the data-preparation process must be thought out prior to the analysis. In this case, the points, which presented the major challenges were reducing the number of states to a number suitable for analysis, handling the overlapping of states and determining how to align trajectories.

Second, the paper aims at providing an understanding of parental leave within the boarder work-family reconciliation trajectories of parents in Luxembourg. The visual representation of sequences, provides a one-glance "snapshot" of the role of parental leave for working parents in Luxembourg. There is a stunning difference between the effects of parenthood on men and women, whereas female trajectories are dramatically influenced by the event of arrival of a new child in the family, while for fathers there seems to be no such relationship.

Third, as a part of a broader PhD thesis, the paper serves the purpose of being the "first step" towards generating further research questions related

to the use of parental leave and work-family reconciliation. Based on the descriptive analysis in this paper, three main directions for further research have been identified.

First, it would be interesting to group similar trajectories together. In the trajectories of women, it would be of special interest to identify the trajectories of women who transition to inactivity, women who reduce hours of employment and women for whom the event of birth does not result in a long-term change in the career trajectory. Grouping of similar trajectories could be achieved by a clustering algorithm, which is a common practice in sequence analysis. Group membership can then subsequently be explained via multiple logistic regression methods.

Second, it would be interesting to explore why some women transition to inactivity after they have a child. This analysis should incorporate the fact that the decision to transition to inactivity can take place in two stages. First, immediately after maternity leave and second after parental leave. It is quite interesting to explore why women transition to inactivity after parental leave. Although the percentage of women in Luxembourg following this pattern of behaviour is not very high, a further consideration of the issue is warranted because in a lot of cases take up of parental leave is assumed to imply a transition back to the labour force afterwards.

Finally, for men, the visualisation of work-family trajectories has displayed that there is not a clear pattern in the timing of parental leave and, in general, the per cent of men using parental leave is still rather small. Parental leave take up is examined in more detail in Zhelyazkova (2013) via a Cox proportional hazards model.

As a whole, the use of sequence analysis methods on administrative records has proven a fruitful approach to the analysis of parental leave in Luxembourg. The visualisation of trajectories has made it possible to trace the main patterns of use of parental leave and to identify further research questions.

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A Sample Characteristics

-	Women		Men	
Nationality				
Luxembourg	1408	31%	1762	30%
France	1137	25%	1432	25%
Belgium	650	14%	815	14%
Germany	216	5%	364	6%
Portugal	593	13%	754	13%
Other	492	11%	710	12%
Missing Values	3	-	2	-
Birth Cohort				
¡1964	213	5%	932	16%
1965-1969	975	22%	1759	30%
1970-1974	1884	42%	2231	38%
1975+	1418	32%	911	16%
Missing Values	3	-	4	-
Birth Order				
First	2618	54%	2710	40%
Second+	2063	42%	3497	53%
Missing Values	200	4%	380	7%
Total	4481	-	5827	-

Table 6: Sample Description

B State Definitions

Colore	Code	Definition	Notes
	D	Dispense	
	B	Birth	Denotes the month when a child was born; Births after 2007 are not recorded
	ML	Maternity/Adoption Leave	In the case of civil servants includes also assumed ML
	PL	Parental Leave Part Time	
	PP	Parental Leave Full Time	
	E¡20	Employed less than 20 hours/week	Includes also 0 hours
	E¡39	Employed between 20 and 39 hours per week	
	E40	Standard Full Time Contract	
	E40+	More than 40 hoours	
	SE	Self-Employed	Includes also part-time self-employed
	S/A	Sickness or Accident Leave	
	F	Family Leave	
	U	Unemployment	Includes also part-time unemployment
	X	No Record	
	COA	No Record with CoInsurance	Possibly out of the country, economically inactive or employed at EU Institutions

Table 7: State Definitions

C Mean Times Spent in Each State

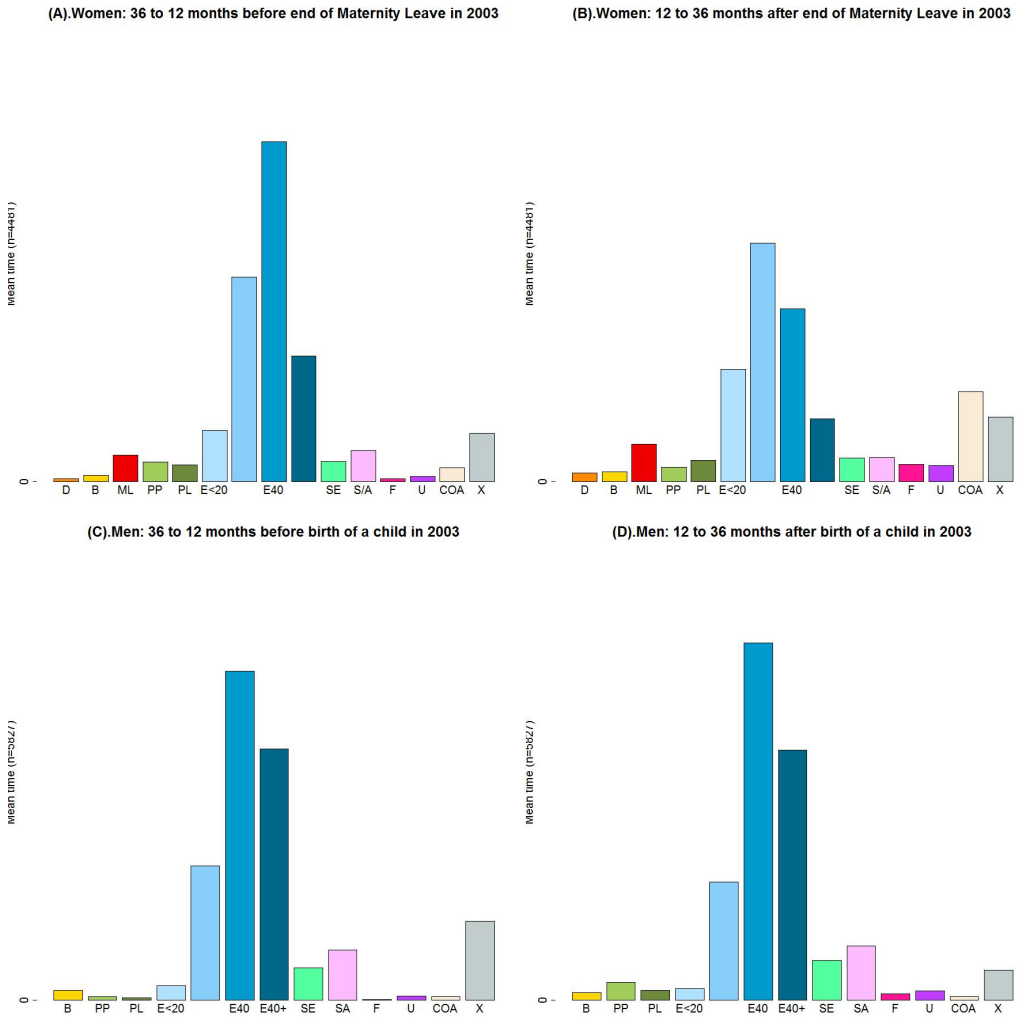

Figure 9: Mean times spent in each state for men and women in Luxembourg who had a child in 2003. Comparable time periods from the trajectories before and after the birth of the child.

D Representative Sequence Sets

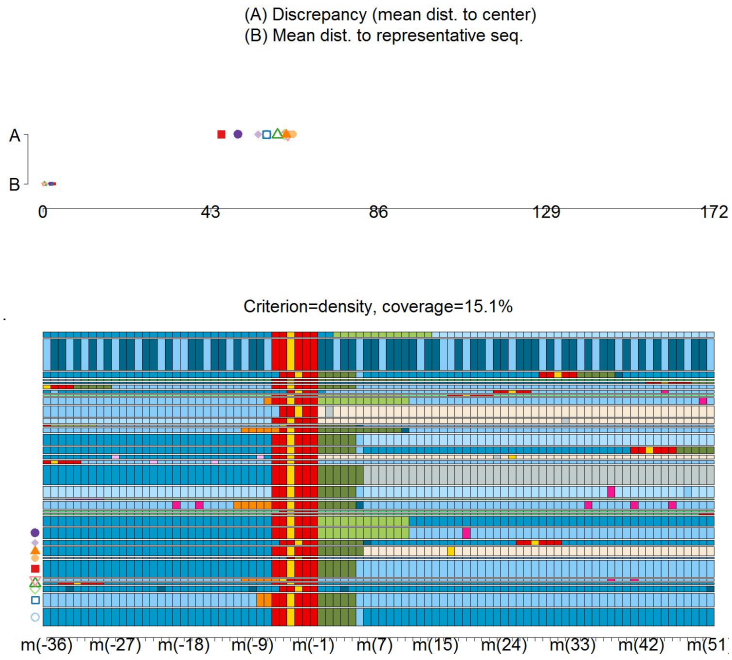

Figure 10: The representative sequence set for women with 15 per cent coverage

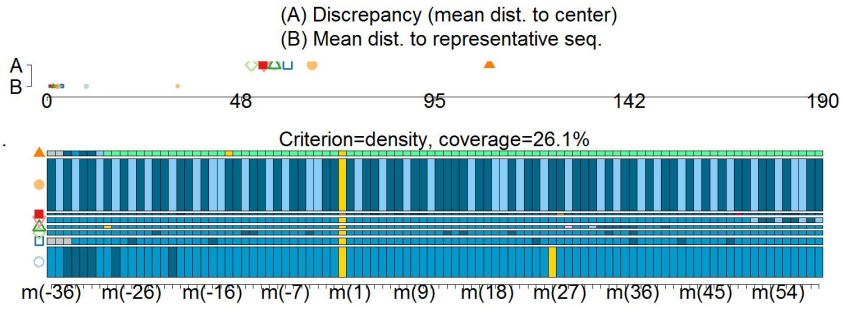

Figure 11: The representative sequence set for men with 25 per cent coverage

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